

CLAIMS

What is claimed is:

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1. A cable based communications network, including a headend controller and a plurality of subscriber terminal units coupled to the headend controller, the system comprised of:

a first virtual private network comprising one or more of the subscriber terminal units;

a second virtual private network comprising one or more of the subscriber terminal units;

a headend controller which communicates with each subscriber terminal unit from the first virtual private network using one or more channels from a first downstream channel group and using one or more channels from a first upstream channel group and a same headend controller which communicates with each subscriber terminal unit from the second virtual private network using one or more channels from a second downstream channel group and using one or more channels from a second upstream channel group.

2. The system of Claim 1, further comprised of:

a subscriber terminal unit which is both a member of the first virtual private network and a member of the second virtual private network;

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a first home equipment which communicates with said subscriber terminal unit, wherein the home equipment is a both member of the first virtual private network and a member of the second virtual private network.

3. The system of Claim 1, further comprised of:

a subscriber terminal unit which is both a member of the first virtual private network and a member of the second virtual private network;

a first home equipment which communicates with said subscriber terminal unit wherein the first home equipment is a member of the first virtual private network.

a second home equipment which communicates with said subscriber terminal unit where the second home equipment is a member of the second virtual private network.

4. The system of Claim 1, wherein:

the first downstream channel group and the first upstream channel group are associated with a first media access control domain;

the second downstream channel group and the second upstream channel group are associated with a second media access control domain.

5. The system of Claim 4, wherein:

the first media access control domain wherein the MAC packet formats are comprised of ATM cells only;

the second media access control domain wherein the MAC packet formats are comprised of ATM cells only.

6. The system of Claim 4, wherein:

the first media access control domain wherein the MAC packet formats are comprised of ATM cells only;

the second media access control domain wherein the MAC packet formats are comprised of combinations of ATM cells and variable length packets.

7. The system of Claim 4, wherein:

the first media access control domain wherein the MAC packet formats are comprised of ATM cells only;

the second media access control domain wherein the MAC packet formats are comprised of and variable length packets only.

8. The system of Claim 4, wherein:

the first media access control domain wherein the MAC packet formats are comprised of combinations of ATM cells and variable length packets;

the second media access control domain wherein the MAC packet formats are comprised of combinations of ATM cells and variable length packets.

9. The system of Claim 4, wherein:

the first media access control domain wherein the MAC packet formats are comprised of combinations of ATM cells and variable length packets;

the second media access control domain wherein the MAC packet formats are comprised of variable length packets only.

10. The system of Claim 4, wherein:

the first media access control domain wherein the MAC packet formats are comprised of variable length packets only;

the second media access control domain wherein the MAC packet formats are comprised of variable length packets only.

11. A cable based communications network, including a headend controller, a plurality of subscriber terminal units coupled to the headend controller, the system comprised of:

a first virtual private network comprising of one or more subscriber terminal units;

a second virtual private network comprising of one or more subscriber terminal units;

a headend controller which communicates with each subscriber terminal unit from the first virtual private network using or more channels from a first downstream channel group and using one or more channels from a first upstream channel group and the same headend controller which communicates with each subscriber terminal unit from the second virtual private network using one or more channels from the first downstream channel group and using one or more channels from the first upstream channel group.

12. The system of Claim 11, further comprised of:

a subscriber terminal unit which is both a member of the first virtual private network and a member of the second virtual private network;

a first home equipment which communicates with said subscriber terminal unit where the home equipment is a both a member of the first virtual private network and a member of the second virtual private network.

13. The system of Claim 11, further comprising:

a subscriber terminal unit which is both a member of the first virtual private network and a member of the second virtual private network;

a first home equipment which communicates with said subscriber terminal unit where the first home equipment is a member of the first virtual private network; and

a second home equipment which communicates with said subscriber terminal unit where the second home equipment is a member of the second virtual private network.

14. A subscriber terminal unit coupled to a cable based communications network, wherein the subscriber terminal unit communicates with one or more home equipment that are members of one or more virtual private networks, comprising:

a subscriber terminal unit which communicates with a headend controller using one or more downstream channels and one or more upstream channels and which is a member of a first virtual private network and a second virtual private network;

a first home equipment which communicates with said subscriber terminal unit and is a member of a first virtual private network.

a second home equipment which communicates with said subscriber terminal unit and is a member of a second virtual private network.

15. A subscriber terminal unit coupled to a cable based communications network, wherein the subscriber terminal unit communicates with one or more home equipment that are members of one or more virtual private networks, comprising:

a subscriber terminal unit which communicates with a headend controller using one or more downstream channels and one or more upstream channels and which is a member of a first virtual private network and a second private network;

a home equipment which communicates with said subscriber terminal unit and is both a member of a first virtual private network and a member of a second virtual private network.

16. A cable based communications network, including a headend controller and a plurality of subscriber terminal units coupled to the headend controller, the system comprised of:

a first virtual private network consisting of one or more subscriber terminal units;

a first set of subscriber terminal units which are members of the first virtual private network which communicate with the headend controller using one or more channels from a first downstream channel group and using

one or more channels from a first upstream channel group, wherein the first downstream channel group and the first upstream channel group are associated with a first MAC domain;

a second set of subscriber terminal units which are members of the first virtual private network which communicate with the headend controller using one or more channels from a second downstream channel group and using one or more channels from a second upstream channel group, wherein the second downstream channel group and the second upstream channel group are associated with a second MAC domain.

17. The system of Claim 16, further comprised of:

a second virtual private network consisting of one or more subscriber terminal units;

a third set of subscriber terminal units which are members of the second virtual private network which communicate with the headend controller using one or more channels from said first downstream channel group and using one or more channels from said a first upstream channel group, wherein said first downstream channel group and said first upstream channel group are associated with said first MAC domains;

a fourth set of subscriber terminal units which are members of said second virtual private network which communicate with the headend controller using one or more channels from said second downstream channel group and using one or more channels from said second upstream channel group, wherein said second downstream channel group and said second upstream channel group are associated with said second MAC domain.

18. The system of Claim 17, further comprised of:

a subscriber terminal unit which is both a member of the first virtual private network and a member of the second virtual private network;

a first home equipment which communicates with said subscriber terminal unit where the home equipment is a both member of the first virtual private network and a member of the second virtual private network.

19. The system of Claim 17, further comprised of:

a subscriber terminal unit which is both a member of the first virtual private network and a member of the second virtual private network;

a first home equipment which communicates with said subscriber terminal unit where the first home equipment is a member of the first virtual private network;

a second home equipment which communicates with said subscriber terminal unit where the second home equipment is a member of the second virtual private network.

20. In a cable based communication network including a headend controller and a plurality of subscriber terminal units coupled to the headend controller, a method of configuring one or more virtual networks between subscriber terminal units, the method comprising the steps of:

grouping one or more of the subscriber terminal units in a first virtual private network;

grouping one or more of the subscriber terminal units in a second virtual private network;

assigning by the headend controller each subscriber terminal unit from the first virtual private network to one or more channels from a first downstream channel group and from one or more channels from a first upstream channel group; and

assigning by the headend controller each subscriber terminal unit from the second virtual private network to one or more channels from a second downstream channel group and from one or more channels from a second upstream channel group.

21. The method of Claim 20, further comprised of the steps:

grouping a subscriber terminal unit in both the first virtual private network and the second virtual private network;

grouping a home equipment which communicates with said subscriber terminal unit in the first virtual private network;

grouping said home equipment which communicates with said subscriber terminal unit in the second virtual private network.

22. The method of claim 20, further comprised of the steps:

grouping a subscriber terminal unit in both the first virtual private network and the second virtual private network;

grouping a first home equipment which communicates with a subscriber terminal unit where the first home equipment is grouped in the first virtual private network; and

grouping a second home equipment which communicates with said subscriber terminal unit where the second home equipment is grouped in the second virtual private network.

23. A method of coupling a subscriber terminal unit coupled to a cable communications network to receive multiple virtual private network communications, comprising the steps of:

attaching a subscriber terminal unit to a cable communications network;

receiving downstream communications on one or more downstream channels;

transmitting communications on one or more upstream channels;

participating in group communications between said subscriber terminal unit and a headend controller for a first virtual private network;

participating in group communications between said subscriber terminal unit and a headend controller for a second virtual private network;

24. The method of Claim 23 further comprised of the steps of:

attaching a home equipment to said subscriber terminal unit;

participating in group communications between said home equipment and said subscriber terminal unit for said first virtual private network;

participating in group communications between said home equipment and said subscriber terminal unit for said second virtual private network.

25. The method of claim 24 further comprised of the steps of:

attaching a first home equipment to said subscriber terminal unit;
attaching a second home equipment to said subscriber terminal unit;
participating in group communications between said first home
equipment and said subscriber terminal unit for said first virtual private
network;

participating in group communications between said second home
equipment and said subscriber terminal unit for said second virtual private
network.

25. The method of Claim 20, further comprising the steps of:
grouping a subscriber terminal unit in both the first virtual private
network and the second virtual private network; and
grouping a second home equipment which communicates with said
subscriber terminal unit where the second home equipment is grouped in the
second virtual private network.

26. A method of coupling a subscriber terminal unit coupled to a cable
communications network communications, comprising the steps of:
attaching a subscriber terminal unit to a cable communications
network;
receiving communications from the headend controller on one or more
downstream channels;
transmitting communications to the headend controller on one or more
upstream channels;

participating in group communications between said subscriber terminal unit and a headend controller for a first virtual private network;

participating in group communications between said subscriber terminal unit and a headend controller for a second virtual private network;

27. The method of Claim 25 further comprising the steps of:

attaching a home equipment to said subscriber terminal unit;

participating in group communications between said home equipment and said subscriber terminal unit for said first virtual private network;

participating in group communications between said home equipment and said subscriber terminal unit for said second virtual private network;

28. The method of Claim 25 further comprising the steps of:

attaching a first home equipment to said subscriber terminal unit;

attaching a second home equipment to said subscriber terminal unit;

participating in group communications between said first home equipment and said subscriber terminal unit for said first virtual private network;

participating in group communications between said second home equipment and said subscriber terminal unit for said second virtual private network.

29. A communication system comprising:

a cable network having one or more downstream channels and one or more upstream channels;

a plurality of subscriber terminal units coupled to the cable network;

a head end controller coupled to the cable network for controlling upstream and downstream communications, wherein the head end controller includes:

a packet interface for receiving packets from subscriber terminal units on a first upstream path;

a packet forwarder coupled to the packet interface for selectively forwarding packets from the packet interface on a first downstream path for transmission over one or more downstream channels to designated subscriber terminal units.

30. The communication system of Claim 29, wherein the head end controller further comprises:

a memory for storing a plurality of valid IP addresses;

a filter coupled to the memory for comparing IP addresses corresponding to an address resolution protocol packet with the valid IP addresses stored in memory, wherein only valid packets are processed and invalid packets are discarded.

31. The communication system of Claim 29, wherein one of the subscriber terminal units comprises:

a memory for storing a plurality of valid IP addresses;

a filter coupled to the memory for comparing IP addresses corresponding to an address resolution protocol packet with the valid IP addresses stored in memory, wherein only valid packets are allowed to proceed upstream and invalid packets are discarded.

32. The communication system of Claim 29, wherein one of the subscriber terminal units is comprised of:

a memory for storing information pertaining to which packets are to be received by the subscriber terminal unit;

a filter coupled to memory for selectively processing only downstream multicast packets according to the information stored in the memory.

33. A subscriber terminal unit, comprising:

an interface for receiving data on one or more downstream channels and for transmitting data on one or more upstream channels;

a first memory coupled to the interface for storing information pertaining to which packets are to be received by the subscriber terminal unit;

a filter coupled to the first memory for selectively processing only downstream multicast packets according to the information stored in the memory;

a second memory for storing a plurality of valid IP addresses;

a filter coupled to the second memory for comparing IP addresses corresponding to an address resolution protocol packet with the valid IP addresses stored in memory, wherein only valid packets are allowed to proceed upstream and invalid packets are discarded.

34. A head end controller, comprising:

a packet interface coupled to an upstream path for receiving upstream packets transmitted from a first subscriber terminal unit on one or more upstream channels;

a packet forwarder coupled to the packet interface for selectively forwarding packets from the packet interface on a downstream path for transmission over one or more downstream channels to a second subscriber terminal unit.

35. The head end controller of Claim 34 further comprising:

a memory for storing a plurality of valid IP addresses;

a filter coupled to the memory for comparing IP addresses corresponding to an address resolution protocol packet with the valid IP addresses stored in memory, wherein only valid packets are processed and invalid packets are discarded.

36. In a communication system, a method for controlling receipt of upstream data and transmission of downstream data, comprising the steps of:

receiving packets transmitted by a subscriber terminals on one or more upstream channels, wherein the packets are received by a packet interface on a first upstream path;

examining the packets to determine destination addresses;

selectively forwarding the packets from the packet interface on a first downstream path for transmission over one or more downstream channels to designated subscriber terminal units according to the destination addresses.

37. The method of Claim 36, wherein the head end controller further comprises the steps of:

storing a plurality of valid IP addresses in a memory;

comparing IP addresses corresponding to an address resolution protocol packet with the valid IP addresses stored in memory to determine whether packets are valid or invalid;

processing valid packets;

discarding invalid packets.

38. The method of Claim 37, further comprising the steps of:

storing information pertaining to which packets are intended to be received by a particular subscriber terminal unit in a memory;

examining each packet received by the particular subscriber terminal unit to determine whether the packet was intended to be received by that particular subscriber terminal unit;

processing only downstream multicast packets that were intended to be received by that particular subscriber terminal unit;

discarding downstream multicast packets that were not intended to be received by that particular subscriber terminal unit.

39. A head end controller for controlling upstream and downstream communications with a plurality of subscriber terminal units, comprising:

an ATM switch for routing ATM packets to the subscriber terminal units according to a virtual connection comprised of a virtual path identifier and a virtual circuit identifier;

a first port card coupled to the ATM switch having a mapping function, wherein a virtual path identifier corresponding to an ATM packet received by the first port card is exchanged with a virtual circuit identifier corresponding to the ATM packet before being input to the ATM switch;

a second port card coupled to the ATM switch having a remapping function, wherein the virtual path identifier corresponding to the ATM packet received by the second port card is exchanged with the virtual circuit identifier.

40. The head end controller of Claim 39, wherein the mapping function exchanges the virtual path identifier with the virtual circuit identifier only when the virtual circuit identifier exceeds a pre-determined threshold.

41. A head end controller for controlling upstream and downstream communications with a plurality of subscriber terminal units, comprising:

an ATM switch for routing ATM packets to the subscriber terminal units according to a virtual connection comprised of a virtual path identifier and a virtual circuit identifier;

a first port card coupled to the ATM switch having a mapping function, wherein a mapping function of a first port card replaces an original value corresponding to the virtual path identifier with a pre-determined value which is routed through the ATM switch and a remapping function of a second port card replaces the pre-determined value of the virtual path identifier with the original value of the virtual path identifier.

42. In a head end controller for controlling upstream and downstream communications with a plurality of subscriber terminal units, a method for routing an ATM packet according to a virtual connection having a virtual path identifier and a virtual circuit identifier, comprising the steps of:

exchanging the virtual path identifier with the virtual circuit identifier of the packet before the packet is input to an ATM switch;

inputting the packet to the ATM switch;

exchanging the virtual path identifier with the virtual circuit identifier after the packet has been routed through the ATM switch.

43. The method of Claim 42 further comprising the step of comparing the virtual circuit identifier with a pre-determined threshold, wherein the virtual path identifier is exchanged with the virtual circuit identifier if the virtual circuit identifier exceeds a pre-determined threshold.

44. In a head end controller for controlling upstream and downstream communications with a plurality of subscriber terminal units, a method for routing an ATM packet according to a virtual connection having a virtual path identifier and a virtual circuit identifier, comprising the steps of:

substituting a pre-determined virtual path identifier in place of an original virtual path identifier prior to inputting the packet to an ATM switch

inputting the packet with the substitute virtual path identifier to the ATM switch;

replacing the original virtual path identifier value in place of the substitute virtual path identifier after the packet has been routed through the ATM switch.

45. A communications network, comprising:

a medium comprised of a plurality of downstream channels and one or more upstream channels;

a user interface which accepts a command from a user indicating the user's preferred latency;

a transmitter coupled to the user interface, wherein data indicating the user's preferred latency is transmitted over one of the upstream channels;

a manager which transmits a first service over one of the downstream channels responsive to the data indicating the user's preferred latency that was received over one of the upstream channels.

46. The communications network of Claim 45, wherein the manager transmits a second service over the downstream channel, wherein the first service and the second service are comprised of either video, game playing, graphics, text, or audio data.

47. The communications network of Claim 45, wherein the manager switches from a first downstream channel for transmission of the first service to a second downstream channel for transmission of the first service in response to receiving data indicating that the user's preferred latency has been changed, the second downstream channel having a different latency than the first downstream channel.

48. In a communications network, a method for transmitting data through a medium having more than one downstream channels and one or more upstream channels, comprising the steps of:

accepting a command from a user indicating the user's preferred latency;
transmitting data indicating the user's preferred latency over one of the upstream channels;

transmitting a first service on one of the downstream channels responsive to the data indicating the user's preferred latency that was received over one of the upstream channels.

49. The method of Claim 48 further comprising the step of transmitting a second service over the downstream channel, wherein the first service and the second service are comprised of either video, game playing, graphics, text, or audio data.

50. The method of Claim 49 further comprising the step of switching from a first downstream channel for transmission of the first service to a second downstream channel for transmission of the first service in response to receiving data indicating that the user's preferred latency has been changed, wherein the second downstream channel has a different latency than the first downstream channel.

51. In a communications network, an apparatus for performing predictive scheduling, comprising:

- a transmitter for transmitting a packet to a destination;
- a memory coupled to the transmitter for storing a set of criteria;
- a processor coupled to the transmitter for examining the packet to determine whether the packet meets any of the criteria stored in the memory,

wherein if the packet meets any of the criteria, a predictive notification is generated;

a scheduler coupled to the processor for scheduling transmissions, wherein when the scheduler receives the predictive notification from the processor, the scheduler generates a grant which the transmitter sends to the source.

52. The apparatus of Claim 51, wherein the transmitter sends the grant before the subscriber terminal unit sends a request corresponding to the received packet.

53. In a communications network, a method for scheduling data transmissions between a subscriber terminal unit and a head end controller, comprising the steps of:

sending a packet from the head end controller to the subscriber terminal unit;

examining the packet to determine whether the first packet meets a specific criteria, wherein if the packet meets the criteria:

generating a predictive notification to a scheduling process to inform the scheduling process that the packet meeting the criteria has been sent;

generating a grant when the scheduling process receives the predictive notification;

sending the grant to the subscriber terminal unit.

54. The communications network of Claim 53, wherein the grant is sent before the subscriber terminal unit sends a request corresponding to the received packet.

55. A communications network, comprising:

a medium having one or more downstream channels and a plurality of upstream channels;

a plurality of subscriber terminal units coupled to the medium;

a head end controller coupled to the medium having a transmitter for transmitting packets downstream to the subscriber terminal units and a plurality of receivers for receiving upstream packets;

a clock generator for generating a timing signal from the transmitter having a variable delay corresponding to a sum of the latencies corresponding to the downstream and upstream channels, wherein the timing signal is input to the receivers for use in performing a ranging function.

56. A communication system comprising:

a cable network having one or more downstream channels and one or more upstream channels;

a plurality of subscriber terminal units coupled to the cable network;

a head end controller coupled to the cable network for controlling upstream and downstream communications, wherein the head end controller includes:

a first receiver for receiving packets from one of the subscriber terminal units on a first upstream path, wherein the first receiver has a corresponding first scheduler which schedules the subscriber terminal units by generating grants based on requests received from the subscriber terminal units;

a transmitter for transmitting a grant generated by the scheduler to a first downstream path;

a packet network coupling the receiver to the transmitter, wherein the packet network carries the grant from the scheduler to the transmitter.

57. The system of Claim 56 further comprising a second receiver coupled to the packet network, wherein the second receiver has a corresponding second scheduler for receiving requests on a second upstream path and generating grants which are transmitted by the first transmitter on the first downstream path.

58. The system of Claim 56 further comprising a second transmitter coupled to the packet network, wherein the grant generated by the first scheduler is transmitted by the first transmitter to the first downstream path and

the grant is also transmitted by the second transmitter to a second downstream path.

59. The system of Claim 56 further comprising:

a second receiver coupled to the packet network, wherein the second receiver has a corresponding second scheduler for receiving requests on a second upstream path and generating grants in response to the received requests;

a second transmitter coupled to the packet network, wherein grants generated by either of the first receiver or second receiver are transmitted by either the first transmitter on the first downstream path or by the second transmitter to a second downstream path.

60. The system of Claim 56, wherein the packet network is comprised of an ATM network.

61. The system of Claim 60, wherein a plurality of grants are included in a single ATM cell.

62. In a communication system having one or more downstream channels and one or more upstream channels coupling a plurality of subscriber terminal units to a headend controller, a method for scheduling the subscriber terminal units, comprising the steps of:

generating a request from one of the subscriber terminal units;

transmitting the request upstream to a first receiver;
generating a grant in response to the request by a first scheduler corresponding to the first receiver;
conveying the request through a packet network to a first transmitter;
transmitting the grant on a first downstream channel to the subscriber terminal unit.

63. The method of Claim 62 further comprising the steps of receiving requests on a second upstream path by a second receiver coupled to the packet network having a second scheduler for generating grants which are transmitted by the first transmitter on the first downstream path.

64. The method of Claim 62 further comprising the step of transmitting the grant by a second transmitter coupled to the packet network.

65. The method of Claim 62 further comprising the steps of:
receiving requests on a second upstream path by a second receiver coupled to the packet network, wherein the second receiver has a corresponding second scheduler;
generating grants by the first scheduler in response to requests received by the first receiver;
generating grants by the second scheduler in response to requests received by the second receiver;

transmitting the grants by the first transmitter or a second transmitter or coupled to the packet network.

66. The method of Claim 62, wherein the packet network is comprised of an ATM network.

67. The method of Claim 62 further comprising the step of including a plurality of grants in a single ATM cell.